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September 29, 1964

TRIP REPORT

PLACE:

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CONTRACT:

"Coherent Light EnLarger"

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DATE: 11 August 1964

Contact was made

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The item of equipment produced under this contract consists of a very highly sophisticated 4X horizontal enlarger equipped with a helium-neon laser light source with spectral emission at 6328 A° and an Osram sodium vapor lamp with emission at 5890 A°.

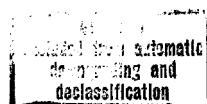
The original objective was to develop an optical system capable of 4x imagery, with a modulation transfer function flat, out to 200 cycles/mm. The basic purpose was to aid the photointerpreter in full exploitation of intelligence information contained in original low contrast imagery recorded at frequencies as high as 200 cycles/mm.

The enlarger consists of three major components: the enlarger assembly; the rack assembly; and the compressor assembly. The film platen which supports the 70mm square film negative section being enlarged, is of the fluid gate type. The air compressor supplies air for an air knife system used in drying the film following each exposure. The rack assembly contains power supplies and other auxiliary components necessary to the operation of the enlarger.

The enlarger optical components are mounted in a horizontal in-line arrangement, with the light source at one end and the enlarging film platen and magazine at the other end. The negative, from which enlargements are to be made, is loaded into the film transport carriage in a manner that allows X and Y movement, to permit selection of targets. A viewing screen and all controls necessary for selection of the target area are centrally located at the operators station.

Declass Review by NIMA / DoD

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Approved For Release 2002/07/12 : CIA-RDP78B04747A002700020019-1

The enlarger produces 9 x 9 inch enlargements from $2\frac{1}{4} \times 2\frac{1}{4}$ inch negatives. The film back consists of an A9A roll film magazine.

A laser source at 6328\AA and a sodium source at 589\AA were provided to allow an evaluation of their relative merits. One of many interesting comparisons between the laser and sodium sources is the relationship between exposure time and relative coherence.* Laser exposure time increases sharply as the coherence decreases. Sodium exposure time decreases sharply as the coherence increases. It has been found that these sources operate at equal exposure efficiency when their respective coherence is adjusted to 87 percent coherence. This gives rise to many questions concerning the various light sources and the percent of coherence most desirable. This is an area of great importance that should be given further study under this program.

An original objective in the development was to provide for spatial filtering in the transform plane. One such filter was provided. It was a graduated filter with a gaussian density variation calculated to improve high frequency contrast in such a manner as to compensate for transfer function loss occurring in original photography. The results of tests with this filter have indicated a need for additional investigation of methods for making spatial filters and ways of using them. In order to achieve the maximum system potential, this should be a subject for further work under this contract.

*Note: The sodium source has a finite bandwidth. The decrease in coherence is achieved by increasing the effective pinhole size, at the focal plane of the collimator. This lets more energy into the system and decreases the required exposure time. Laser source has its coherence decreased through diffusion, thus requiring more exposure time to compensate. There is nothing magical about either phenomenon.

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20 Perhaps the most difficult problem in the enlarger development is the myriad of diffraction patterns in the image due to minute artifacts and dust particles in the optical system. This problem was recognized at the outset of the program and has proven to be extremely persistent and difficult to control. During the enlarger development certain control measures were developed that reduced the severity of the interference patterns. However, considerable study work remains to be done on various aspects of the problem, such as reducing the exposure requirement and optimizing the condenser optics. These optical aspects represent a third area requiring considerable further work to assure maximum benefit from the program.

Another subject requiring additional study concerns methods for numerical evaluation of the enlarger. The method long considered has been to plot the modulation transfer function from sine-wave images. In actual tests, however, the modulation transfer function measured radially and tangentially varied between .18 and .75 from the same target, on axis. The reason for this difference is not understood and should be studied further. These two values should be the same when measured on the axis.

From a mechanical point of view the enlarger was very well engineered and packaged. There were, however, two items that should be changed, and other features that should be added to assure maximum utility of the enlarger. These are briefly described below:

- a. The reflex viewer screen was in a position at a right angle to the enlarger axis that was awkward for operator viewing from a normal sitting position at the control panel. The screen should be canted towards the operator.
- b. The magazine film back is too cumbersome to use in practical applications. The use of roll film in a magazine would make it difficult to remove short pieces for immediate processing. A cut sheet film back should be provided.

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Automatic exposure control should be provided to assure correct exposures, this is of particular importance for intelligence exploitation because maximum resolution can only be achieved by correct exposure and correct processing.

Completion Date

The enlarger was originally scheduled for delivery late in July. The unit was in fact completed from a mechanical point of view. However, during separate inspections on the dates of 11 and 19 August 1964 it was apparent that although the unit was complete, much conceptual theory was yet to be proven and that further investigative work should be performed before the enlarger would be ready for any sort of production work at NPIC. This was the opinion of the monitor on 11 August [redacted] in company of the monitor on 19 August agreed with the judgement that the enlarger should remain at the [redacted] plant for further study of the principles employed.

25X1

Conclusions

It is concluded:

- a. From a mechanical point of view the coherent light enlarger is complete and well engineered.
- b. From a conceptual point of view much study work is yet to be performed before full value of the program can be realized.
- c. Sufficient funds remain in the contract to complete the proposed work.
- d. Additional study work under the program as indicated by review of the program on 11 and 19 August should be performed before the unit is delivered.
- e. The mechanical changes should be deferred pending satisfactory answers to the several problems of theory.

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Recommendations.

It is recommended that:

- a. The enlarger not be delivered to NPIC until more is known about the optical phenomena peculiar to the system.
- b. The contractor be permitted to continue study in the questionable areas referred to herein with the funds remaining in the contract.
- c. The contract delivery data be extended to 15 January 1965.

25X1

Distribution:

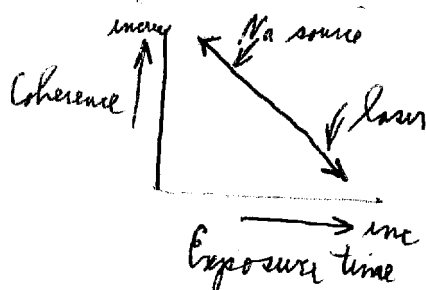
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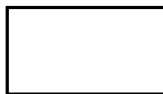
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Artifact: "A product human workmanship,
especially of simple primitive workmanship."



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MEMORANDUM FOR:



concerned,

One other point —
Page 3, para 2, radial
MTF of .18 must be im-
proved significantly before
the instrument would serve
its intended purpose — also
the artifacts must go.

ZLN

(DATE)

15 Oct 64

FORM NO. 101 REPLACES FORM 10-101
1 AUG 54 WHICH MAY BE USED.

(47)

25X1

AGENDA 25 Sep 63

I Breadboard Results to Date

A Investigations

Fluid index

Laser uniformity

Laser interference rings

Diffuser

Glass scratch and digs

Spectral mask

Focal depth

Phase

B Enlargements

C Publication permitted?

II Prototype Design

A Layout recommendations

Horizontal

Console, operator position, operation

Frame and roll

Filter design

B Customer choices

Data form

Color

C Interface

28 V D.C.

Piers?

D Schedule

1. Films 4400
4401
8400
8401

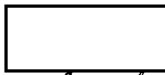
2. Using T-11

3. Mag. 3.5x = Breadboard

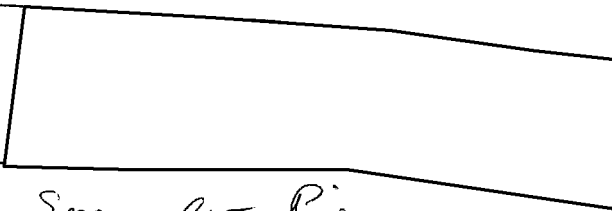
4. Laser Intensity Varies as expected

5. Spectra-Rhymir-PE Laser

6. Focal depth of a few tenths of a thousand. (a reasonable order)

7. Probably will use  Camera w/A9 mag. Look at Data Block

8. What is total weight

9. 

10. Spec for Piers

11. Elevator Size

12. Briefing Mats

13. Dynamic Future

14.

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